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PATENT SPECIFICATION

DRAWINGS ATTACHED

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Inventor: GEORGE FREDERICK BERRIDGE

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COMPLETE SPECIFICATION

Improvements in and relating to Cathode Ray Tubes

We, THORN-A.E.I. RADIO VALVES AND TUBES LIMITED, a British Company, of Thorn House, Upper St. Martin's Lane, London, W.C.2, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a method of so treating cathode ray tubes as to reduce the risk of implosion in the event of damage to the cathode ray tube, and to cathode ray tubes treated by the method.

The glass envelope of a type of cathode ray tube currently in use consists of a relatively thick glass plate at the front and a funnel-shaped portion of relatively thin glass behind the plate. The usual procedure for assembling such a cathode ray tube is to seal the larger end of the funnel to the outer edge of the front plate by fusing the glass.

Either before or after the sealing operation, a layer of phosphor is deposited upon the inside of the front plate followed by an evaporated film of aluminium, and the inside of the funnel portion is coated with graphite to form a second anode. Into the small end of the funnel is sealed a member including a stem carrying an electron gun and a gass tube by means of which the cathode ray tube envelope may be exhausted. When the cathode ray tube has been sufficiently exhausted the exhaust tube is closed by heating it until the glass melts and forms a solid tip over the end of the tube.

As there is now an almost complete vacuum inside the cathode ray tube the glass envelope has to withstand an external pressure of about 14.7 lb/sq. in. (the atmospheric pressure) uncompensated by any internal pressure. In the event of the glass envelope being damaged, perhaps by a scratch on the thin funnel portion, the entire envelope may shatter in such a way that pieces of glass are projected over a wide area with considerable velocities. Such a failure, accompanied by a sudden rush of air into the previously evacuated space, is known as an implosion. Severe injuries may be sustained, for example by an operator, not only from flying glass, but also from the sudden, temporary, removal of the atmospheric pressure from in front of the operator's face.

Some protection is therefore necessary and is usually afforded by placing a screen of glass or other transparent material in front of the cathode ray tube and by enclosing the remainder of the cathode ray tube in a cabinet. However, any safety screen in front of the cathode ray tube is bound to absorb some of the transmitted light, and as regards the cabinet, this may well have to be removed at some time to facilitate adjustment of the cathode ray tube or associated apparatus. It is an object of the present invention so to treat a cathode ray tube that if it is damaged it breaks without implosion. Such a cathode ray tube would be safe whether in a cabinet or not, and the operator would not have to be protected by a screen.

It is known that the risk of implosion may be reduced by applying a covering of glass fibres to the funnel-shaped portion of cathode ray tube and by clamping a steel band round the perimeter of the front plate.

In accordance with the present invention, a method of treating a cathode ray tube, having a front plate and a funnel portion constituting an evacuated envelope, to reduce the risk of imposion, includes the steps of applying a coating of synthetic resin to a region of the surface of the envelope, this region being a circumferential surface strip close to or overlapping the join of the funnel portion with the front plate and including those zones of the funnel portion in which the stress caused by evacuation is a maximum, providing round this region a tightly-wound winding of a multi-strand string or roving of synthetic material, impregnating the winding with synthetic resin before, after or while the winding is applied

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to the region, and curing, or allowing to cure, all the applied resin in such a way that the winding is fixed firmly to the surface and exerts an inward force on the surface. A preferred method of carrying out the invention also includes the further steps of coating the winding and a part of the funnel portion extending from the larger end thereof with synthetic resin whilst masking the anode and other terminals from the resin, placing on the resin a cone of matting of synthetic material so shaped as to fit closely over the winding and the said part of the funnel portion, and impregnating the matting with synthetic resin which is then cured or is allowed to cure.

Further, according to the invention, there is provided a cathode ray tube treated to reduce the risk of implosion, comprising a front plate and a funnel portion constituting an evacuated envelope, and a tightly-wound winding of multi-strand string or roving of synthetic material fastened to the envelope round a circumferential surface strip close to or overlapping the join of the funnel portion with the front plate and including those zones of the funnel portion in which the stress caused by evacuation is a maximum, the winding being fixed firmly to the envelope by synthetic resin in such a way that the winding exerts an inward force on the surface of the envelope. Also, in accordance with the invention, there is provided a cathode ray tube which has been treated by the method according to the invention.

It is one advantage of the present invention over the use of a steel band clamped round a cathode ray tube, that, by using the winding of roving or string embedded in synthetic resin, all parts of the said stressed region have inwardly directed, retaining forces applied thereto despite surface irregularities in the glass and curvature of the glass in three dimensions.

One embodiment of the invention will now be described, by way of example, with reference to the accompanying drawing which shows a diagrammatic cross-section of a cathode ray tube treated by the method according to the invention.

In the following description of the method according to the invention, reference numerals appended to the completed cathode ray tube shown in the Figure will also be used to denote the same parts in earlier stages of the method.

Before a number of cathode ray tubes of a given type can be treated it is necessary to determine, for one cathode ray tube of the type (such as the cathode ray tube 10 shown in the drawing), the position of the circumferential surface strip containing the zones of maximum stress. Strain gauges, for example resistance strain gauges, are fastened, before the evacuation of a cathode ray tube, to the surface of the envelope thereof in the region of the joint between the front plate 11 and funnel portion 12. Readings from these gauges are noted during the evacuation of the tube. From these readings the positions of the zones of maximum stress can be determined. Thus the position of the circumferential surface strip, around which the roving is to be wound, may be found.

To the circumferential surface strip 13 is applied a coating of synthetic resin such as a polyester resin of the type which cures in about ten minutes without the use of heat. The resin is allowed to jell for about five minutes after which some glass roving 14 is wound several times round the circumferential surface strip. The roving passes through a bath of resin before the winding operation and so is thoroughly impregnated with resin. The roving is kept in tension during the winding operation, for example a pull of 50 lbs gives good results, whereby the roving bites into the resin coating. When the winding operation is complete the resin is usually sufficiently cured to allow the release of the tension without visible movement of the winding. The resin is then allowed to cure completely (the resin being left for at least one hour) so that the roving 14 is fixedly firmly to the surface 13 and exerts inwardly-directed forces on the surface. If necessary the resin is allowed to cure while the roving is held in tension.

The roving 14, the edges 19 of the front plate 11 and a part of the funnel portion 12 extending approximately from the edges 19 of the front plate to a position on the funnel portion indicated by the reference numeral 20, are then coated with more resin 15, a mask being used to shield the area round the anode and other terminals, such as the terminal 16 of the electron gun 17. The resin 15 is allowed to jell for about 5 minutes after which there is fitted over it a cone of matting 18 of synthetic material such as glass fibre. The matting 18 is so shaped as to fit closely over the said part of the funnel portion 12, the glass roving 14 and the edges 19 of the front plate. The matting 18 is impregnated with resin which is well rolled in and then allowed to cure, thus fixing the matting to the glass surface and to the glass roving without including air pockets.

It will be understood that the resin need not be of the polyester type, another suitable resin being of the epoxy type, and that a synthetic resin needing heat to be cured could be employed. Furthermore fibres of synthetic material other than glass can be used in the roving and in the matting, fibres of nylon being an example of an alternative. The matting used could consist of "woven matting," "chopped strand mats," needled on mats" or even "chopped lengths of roving."

A "needled-on mat" is made by taking a woven fabric and making a form of pile on it by inserting a thread carried by a needle to form a series of loops and then cutting the

tops off the loops. Some cheaper forms of household carpet are produced in this form. In the present case, the mat is made of glass fibre.

There is claimed in British patent specification No. 929,090 a cathode ray tube for displaying images comprising a glass bulb which is coated at least in part by a synthetic resin layer wherein the said synthetic resin layer includes fibrous material at least in the area in which said layer covers the zone adjoining the image area of the tube face and extending over part of the bulb.

WHAT WE CLAIM IS:—

1. A method of treating a cathode ray tube, having a front plate and a funnel portion constituting an evacuated envelope, to reduce the risk of implosion, including the steps of applying a coating of synthetic resin to a region of the surface of the envelope, this region being a circumferential surface strip close to or overlapping the join of the funnel portion with the front plate and including those zones of the funnel portion in which the stress caused by evacuation is a maximum, providing round this region a tightly-wound winding of a multi-strand string or roving of synthetic material, impregnating the winding with synthetic resin before, after or while the winding is applied to the region, and curing, or allowing to cure, all the applied resin in such a way that the winding is fixed firmly to the surface and exerts an inward force on the surface.

2. A method according to claim 1, wherein the applied resin is cured, or allowed to cure, partially or completely, while the winding is held in tension.

3. A method according to claim 1 or 2, wherein the winding consists of a plurality of turns of string or roving.

4. A method according to claim 1, 2, or 3, including the steps of coating the winding and a part of the funnel portion extending from the larger end thereof with synthetic resin, placing on the resin a cone of matting of synthetic material so shaped as to fit closely over the winding and the said part of the funnel portion, impregnating the matting with synthetic resin, and curing, or allowing to cure, all the applied resin.

5. A method according to claim 4, wherein one or more terminals of the cathode ray tube are masked while the resin coating is applied to the winding and the said part of the funnel portions.

6. A method according to any one of claims 1 to 5, including the step of determining the position of those zones of the funnel portion in which the stress caused by evacuation is a maximum, by fastening strain gauges to the cathode ray tube, or to another cathode ray tube of the same shape, before the evacuation of the envelope thereof, the gauges being fastened to the surface of the envelope in the region of the join between the front plate and the funnel portion, and the readings of the gauges being noted before and after evacuation to determine the positions of the zones of maximum stress.

7. A method according to any one of claims 1 to 6, wherein the synthetic material is glass fibre.

8. A method according to any one of claims 1 to 7, wherein the resin is a polyester or epoxy resin.

9. A cathode ray tube treated to reduce the risk of implosion, comprising a front plate and a funnel portion constituting an evacuated envelope, and a tightly-wound winding of a multi-strand string or roving of synthetic material fastened to the envelope round a circumferential surface strip close to or overlapping the join of the funnel portion with the front plate and including those zones of the funnel portion in which the stress caused by evacuation is a maximum, the winding being fixed firmly to the envelope by synthetic resin in such a way that the winding exerts an inward force on the surface of the envelope.

10. A cathode ray tube according to claim 9, having a cone of matting of synthetic material so shaped as to fit closely over the winding and a part of the funnel portion extending from the larger end thereof, the matting being fixed to the winding and the said part of the funnel portion by synthetic resin.

11. A method of treating a cathode ray tube to reduce the risk of implosion, substantially as hereinbefore described with reference to the accompanying drawing.

12. A cathode ray tube which has been treated by the method according to any one of claims 1 to 8, or claim 11.

REDDIE & GROSE,
Agents for the Applicants,
6, Bream's Buildings, London, E.C.4.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*